



Upgrading MINERvA for Future Runs: Challenges for DAQ and Light Yield

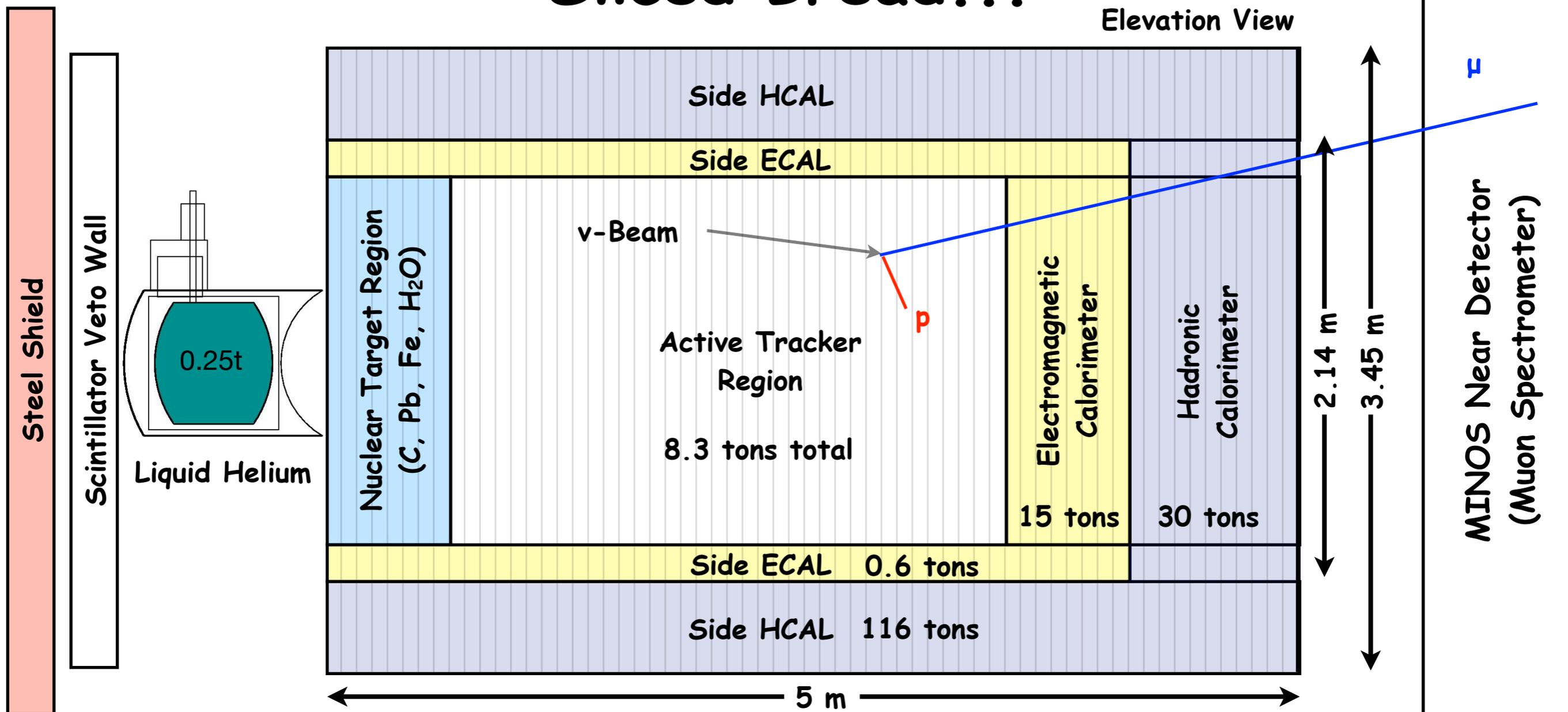
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Looking Forward

- It is easy to assume that detectors that are around and working now will be around and working forever.
- This is not a good assumption.

The Best Thing Since Sliced Bread...



The MINERvA detector is comprised of a stack of MODULES of varying composition, with the MINOS Near Detector acting as a muon spectrometer. It is finely segmented (~32 k channels) with multiple nuclear targets (C, CH, Fe, Pb, He, H₂O).



MINERvA Readout

- Fundamental technology: Plastic scintillator, wavelength-shifting fiber, multi-anode PMTs.
- Readout: custom FEBs, custom VME boards, PCI to rack-mount PC.
- FEBs speak LVDS (Cat6 ethernet).



Readout Issues

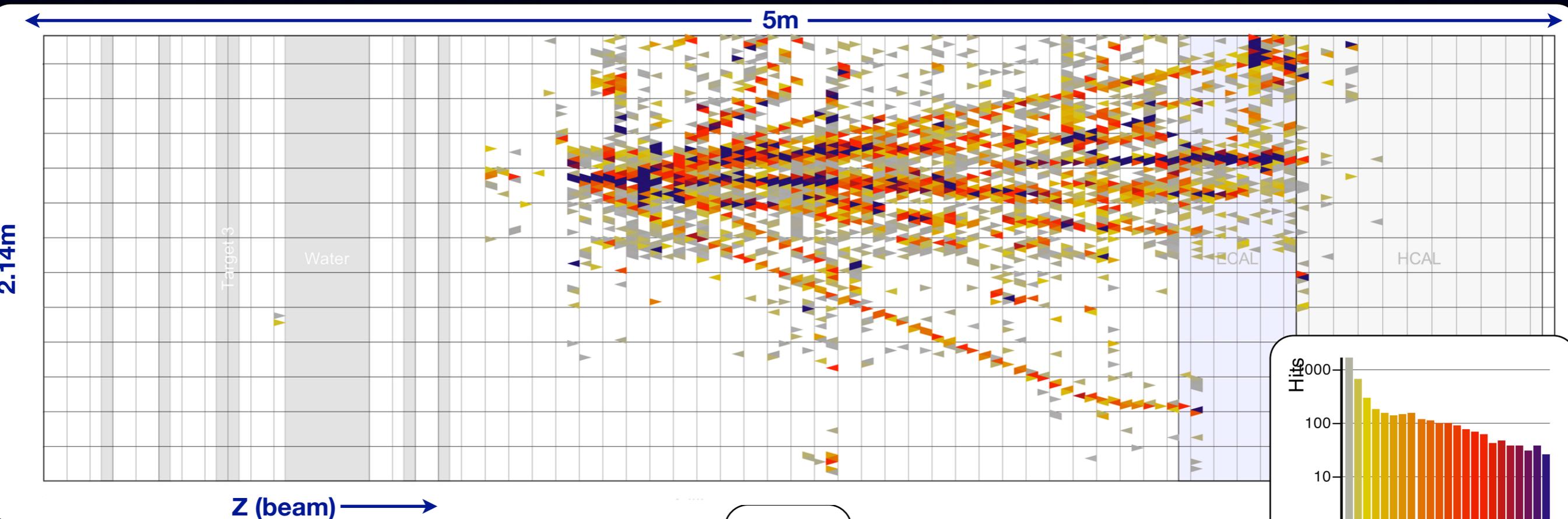
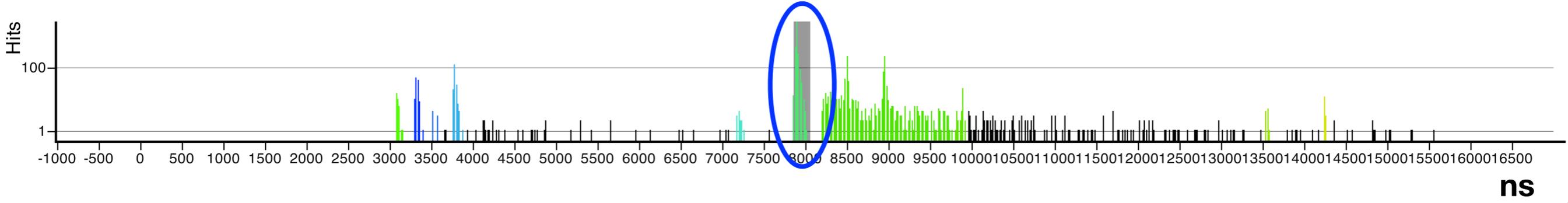
- Readout is slow ~ 1 MB/s.
- 1 physics & 1 calibration / spill.
- Readout is currently \sim serial.
- New interface card will allow parallelization $\sim 5-10x$ faster.
- $< \$100k$; **NEEDED** for NOvA Era.



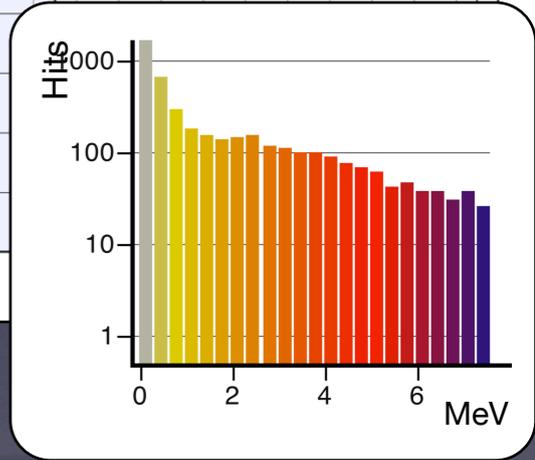
Readout Issues

- FEBs read 7(+1) hit buffers.
- PMTs "after-pulse" - wastes buffers, introduces deadtime.
- High intensity / energy uses more buffers.
- Low Energy is okay, others...?

X-View Close-Up

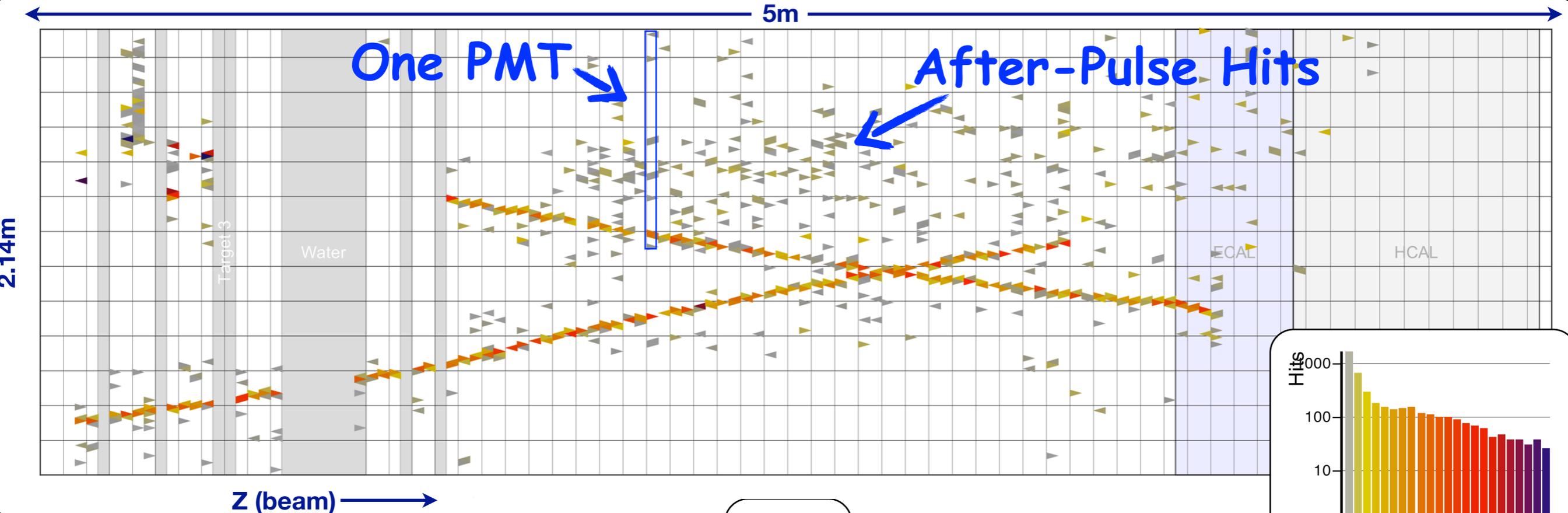
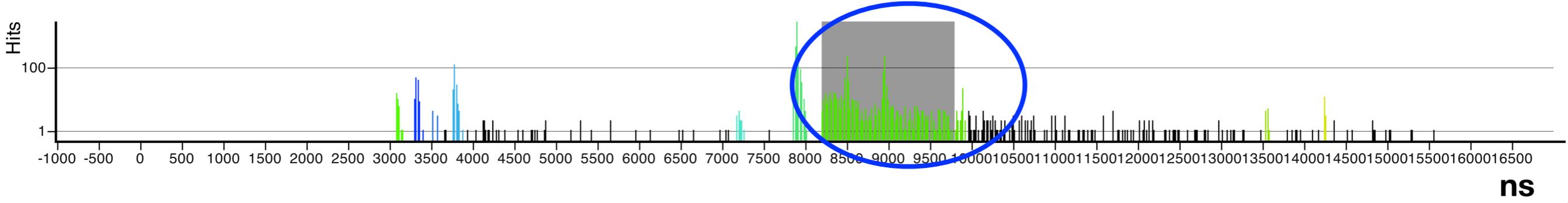


X-View

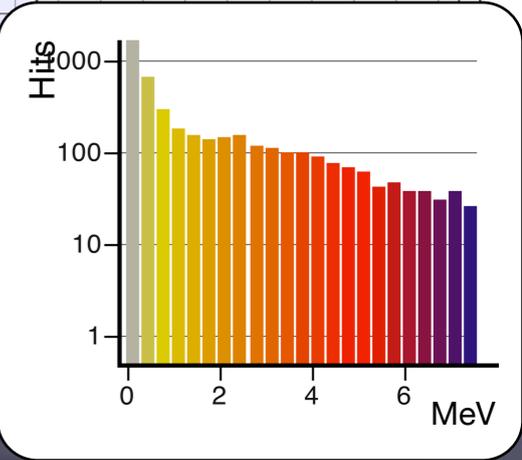


DATA: Run 2298/1/29/7

X-View Close-Up



X-View



DATA: Run 2298/1/29/8



Readout Fixes

- SiPMs would solve the after-pulsing problem.
- Are 7(+1) hit buffers sufficient in higher energy configurations with no after-pulsing?
- Need a study. And a few $\$10^6$.



Readout Fixes

- SiPMs would also help with light yield.
- Currently ~ 5 p.e./MeV.
- Drop @ \sim few % per year (scintillator aging) \rightarrow $\sim 30\%$ loss over a decade.

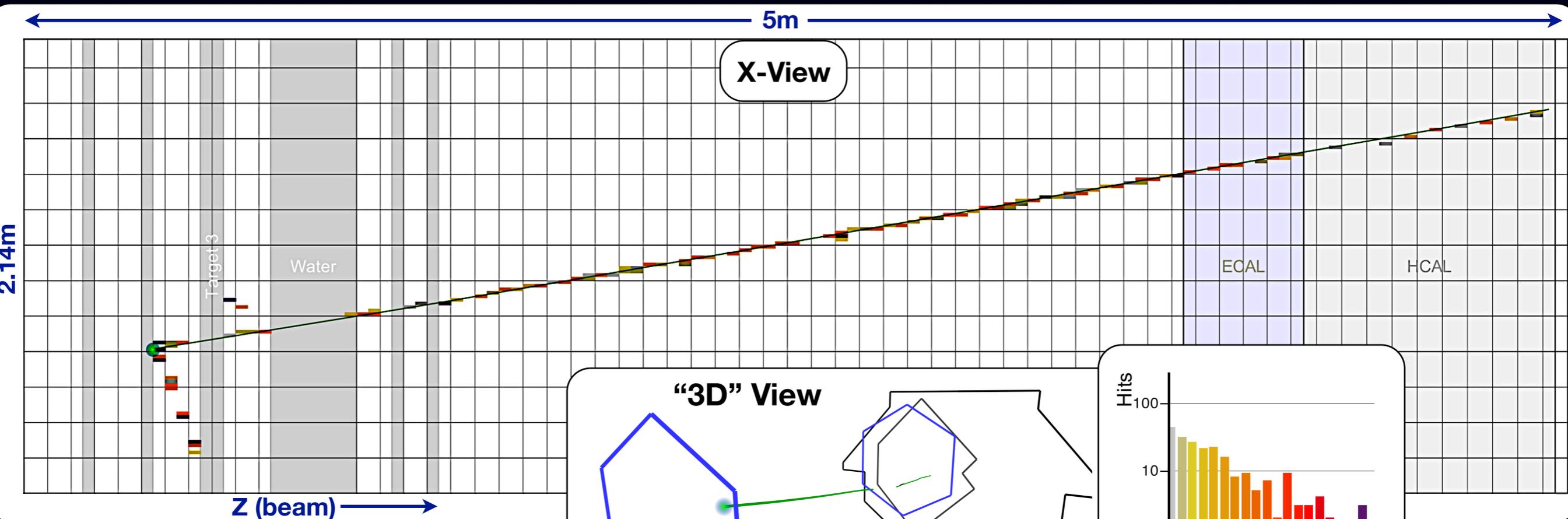
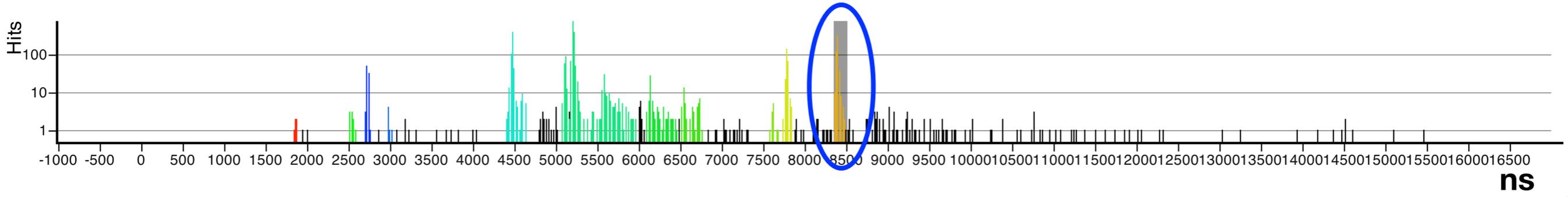


Thanks for
Listening!

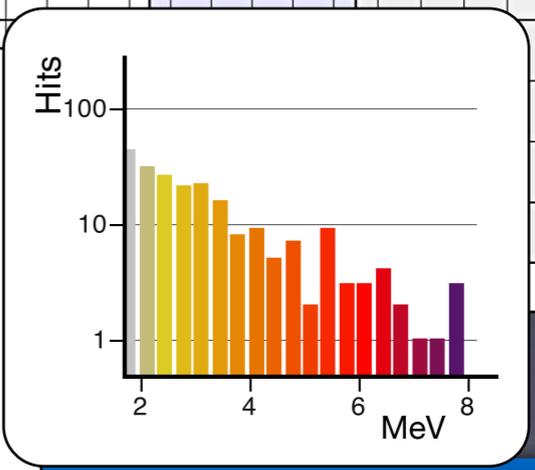
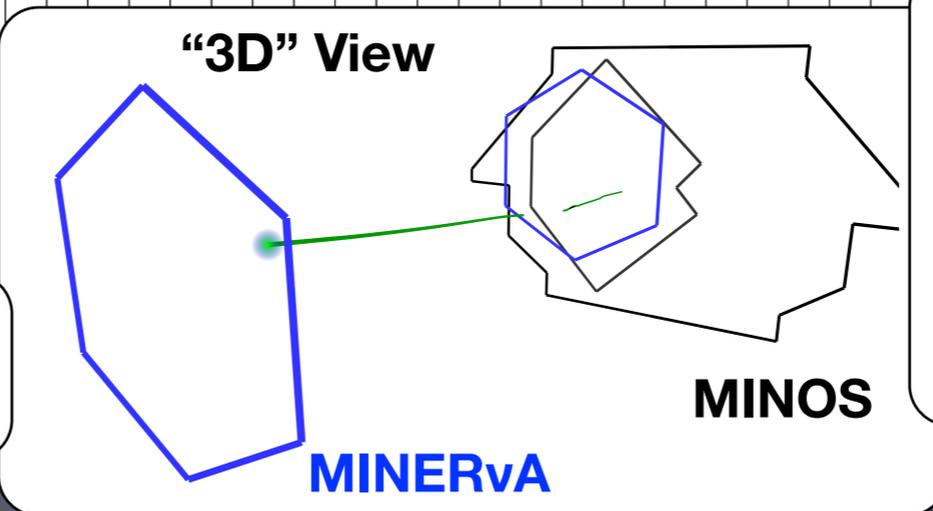


Backup

X-View Close-Up



**Charged Current Event Candidate
on Iron Nuclear Target**



DATA: Run 2298/1/33/12